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PRELIMINARY EXTERNAL-DOSE ESTIMATES FOR FUTURE BIKINI ATOLL INHABITANTS

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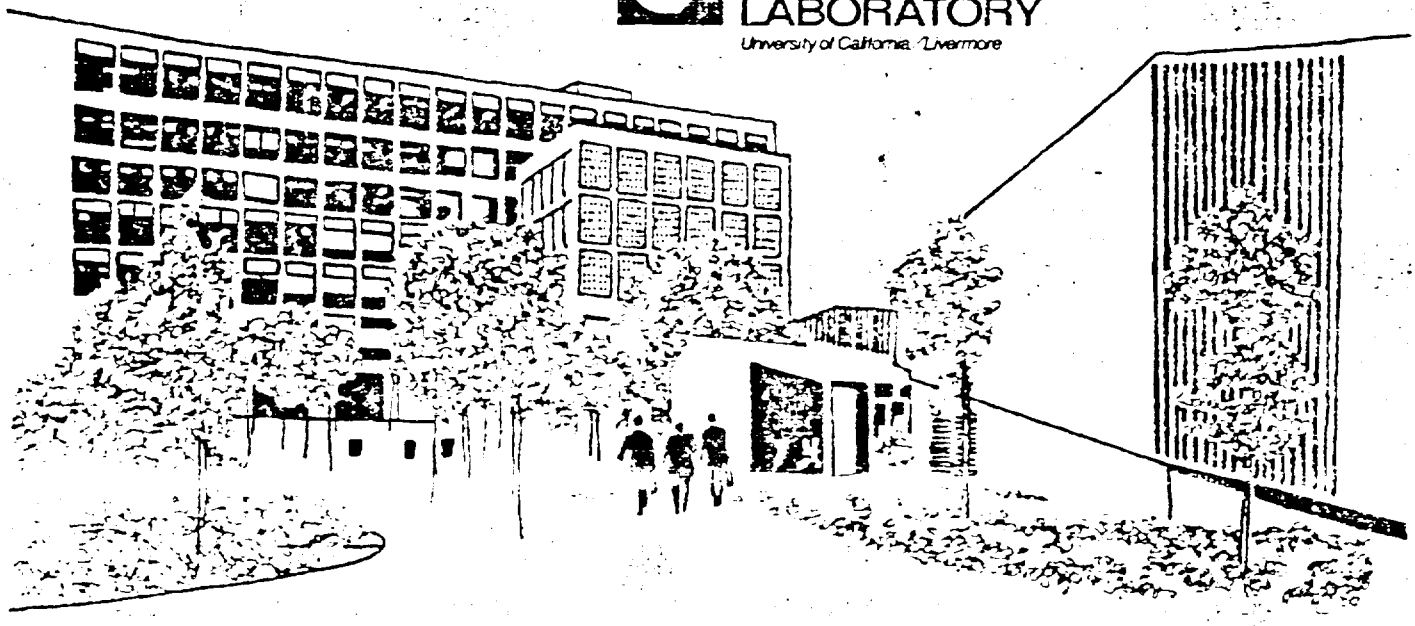
University of California/Livermore



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The field portion of the June 1975 radiological survey of Bikini and Eneu Islands of Bikini Atoll was accomplished by a very intense and thorough effort by 21 people representing six different organizations. The number of samples collected and the amount of information obtained during the ten-day survey is a direct result of the cooperation and diligent effort of the following individuals:

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William L. Robison
Technical Director

PRELIMINARY EXTERNAL-DOSE ESTIMATES FOR FUTURE BIKINI ATOLL INHABITANTS

Abstract

With the objective of evaluating the potential radiation doses that may be received by the returning Bikinians, a survey was conducted during June 1975 of the residual radioactivity in the terrestrial environment on Bikini and Eneu Islands of Bikini Atoll. The survey included measuring environmental gamma-ray exposure rates for use in evaluating the external gamma doses, and collecting numerous soil, lens water, and vegetation samples for use in assessing the internal doses via pertinent food chains. This report describes the gamma-ray exposure rate measurements and their use in conjunction with population statistics and expected life styles for evaluating the potential external gamma-ray doses associated with various options for housing locations on Bikini and Eneu Islands. (The evaluation of the internal dose contribution via food chains will be published in subsequent reports.)

The results of the survey reveal that the external exposure rates on Bikini Island are highly variable. Values near the shores are generally of the order of 10-20 μR/hr, while those within the interior average about 40 μR/hr with a range of roughly 30-100 μR/hr. Eneu Island, however, is characterized by more or less uniformly distributed gamma radiation levels of less than 10 μR/hr over the entire island.

For the external dose determination a set of most likely living patterns was chosen. These were based upon the various options for housing locations along the lagoon road and within the interior portions of Bikini Island as well as along the lagoon side of Eneu Island. As expected, living on Eneu Island results in the lowest doses: 0.12 rem during the first year and 2.7 rem during 30 years. The highest values, 0.28 rem during the first year and 5.7 rem over 30 years, may potentially be received by inhabitants living within the interior of Bikini Island. Other options under consideration produce intermediate values.

Introduction

A radiological survey of Bikini and Eneu Islands of the Bikini Atoll was conducted during June 1975 to assess the potential radiation doses that may be received by the returning Bikinians. Bikini Atoll was one of the U.S. nuclear weapons testing sites in the Pacific. It is situated in the northern part of Micronesia in the Central Pacific Ocean about 3600 km southwest of Honolulu. The atoll consists of a number of small islands on an elliptical coral reef surrounding a lagoon with major and minor axes having dimensions of 35 and 27 km, respectively. The islands are shown in Fig. 1. The total

land area is about 6 km^2, and the land height generally averages 3-5 m above mean sea level. The islands vary in size from small sandbars of a few hundred square meters in area to islands having areas of about 2 km^2. The islands of most importance for immediate habitation are Bikini and Eneu Islands.

A total of 23 nuclear tests took place during the testing period. Most of the tests were conducted on barges anchored in the lagoon or on the reef. All islands were subjected to varying degrees of close-in fallout. Generally, the prevailing winds transported the radioactive debris clouds toward the southwest. One exception, however, occurred during the Bravo event when unexpected changes in the wind directions caused the cloud to travel toward the east over Bikini Island. Most of the radioactive contamination on Bikini Island is due to this event.

This recent survey was designed to evaluate the potential external gamma doses associated with proposed housing locations on Bikini and Eneu Islands, and to evaluate the potential doses received through the major terrestrial food crops on the atoll. The survey teams therefore directed their efforts in three major areas: (1) Gamma-ray exposure rate measurements and surface soil collections will provide a means for evaluating the external gamma doses associated with proposed housing locations. Gamma spectral analyses of the soil samples will provide information on the fractional contributions of different radionuclides to the external dose. This will enable us to evaluate long-term whole-body doses from this exposure pathway. (2) Collection of lens water samples will supply information on the radionuclide activity levels in the groundwater and on the cycling of radionuclides in the atoll ecosystem. In addition, salinity measurements and lens capacity measurements were made at each well to determine the quality and quantity of water available to the Bikini people for irrigation and/or drinking. (3) Vegetation-soil collections will provide information concerning the radionuclide concentrations in critical food products to evaluate the dose contribution via food chains. It will also provide information on the correlation between soil type, soil radionuclide concentrations, and radionuclide concentrations in key food plants and indicator plant species, which is necessary in order to develop predictive models.

This is the first in a series of reports which will be based upon the June 1975 survey data; it is directed only at preliminary estimates of the external gamma-ray doses. The report describes our techniques for measuring geographical variability of the gamma-ray exposure rates on Bikini and Eneu Islands and how we used the resulting data in conjunction with population statistics and expected living patterns to estimate the external gamma doses. Estimates of the integral first-year and 30-year doses associated with various options for housing locations on Bikini and Eneu Islands are presented and compared with appropriate guide values. The reader should note that these estimates are still preliminary in nature and may undergo changes when all of the results of the survey become available. Further information concerning radiation doses that may potentially be received via groundwater and various food chains will be published upon the completion of the analyses of the many soil, vegetation, and water samples that were collected during the survey.